

WHAT IS CLAIMED IS:

- 1               1. A hydraulically settable lightweight concrete composition  
2 which cures to a cured composite following addition of water and exhibits strain  
3 hardening behavior following cure, said composition comprising  
4               a) a brittle inorganic matrix precursor;  
5               b) reinforcing fibers having a minimum average length of about  
6               4 mm, present in an amount of from 0.5 volume percent to  
7               less than 4 volume percent based on the total volume of cured  
8               composite;  
9               c) at least one lightweight aggregate having a mean particle size  
10               in the range of 10  $\mu\text{m}$  to 1000  $\mu\text{m}$ , in an amount effective to  
11               achieve a target density in said cured composite below about  
12               2000  $\text{kg}/\text{m}^2$ .
- 1               2. The composition of claim 1, wherein said reinforcing fibers  
2 comprise polymeric reinforcing fibers having a mean diameter from 10 to 60  $\mu\text{m}$ ,  
3 a mean length of 4 mm to 30 mm, a strength of 800 MPa or higher, a modulus of  
4 elasticity of 10 to 300 GPa, interfacial chemical bonding below 4.0 J/m<sup>2</sup>, interface  
5 frictional stress from 0.5 to 3.0 MPa, and an interface slip hardening coefficient  
6 below 3.0.
- 1               3. The composition of claim 1, wherein said lightweight  
2 aggregate comprises microballoons having a mean diameter of from 10  $\mu\text{m}$  to 100  
3  $\mu\text{m}$ .
- 4               4. The composition of claim 3, wherein said microballoons have  
5 walls of glass, ceramic, or polymer.
- 1               5. The composition of claim 1, wherein said brittle inorganic  
2 matrix precursor comprises a hydraulically settable cement or an inorganic polymer.

1                   6.       The composition of claim 1, wherein said brittle inorganic  
2 matrix precursor comprises a Portand cement.

1                   7.       The composition of claim 1, comprising, for each one part by  
2 weight of cement, from 1.0 to 3.0 volume patent reinforcing organic fibers and  
3 sufficient lightweight aggregate to achieve a density, when cured by addition of  
4 water, of from 800 kg/m<sup>3</sup> to 1900 kg/m<sup>3</sup>.

1                   8.       The composition of claim 1, wherein said reinforcing fibers  
2 are selected from the group consisting of high density polyethylene fibers, polyvinyl  
3 alcohol fibers, and polyarylamide fibers.

1                   9.       The composition of claim 1, wherein said fibers contain polar  
2 or hydrophilic groups.

1                   10.      The composition of claim 1, wherein at least a portion of said  
2 lightweight aggregate comprises gas filled voids.

1                   11.      The composition of claim 1, wherein gas filled voids are  
2 present, and a cured composite achieved by adding water and curing, has a density  
3 of from 1500 kg/m<sup>3</sup> to 1900 kg/m<sup>3</sup>.

1                   12.      A fiber reinforced lightweight concrete structure, comprising  
2 a cured, fiber reinforced brittle matrix composite prepared by adding water to the  
3 composition of claim 1 to form a hydraulically curable composition, and allowing  
4 said curable composition to cure.

1                   13.      The composite of claim 9 which has a density in the range of  
2 800 to 2000 kg/m<sup>3</sup> and exhibits a tensile strain of 2% or greater.

1                   14.      The composite of claim 9 which has a density in the range of  
2 900 kg/m<sup>3</sup> to 1600 kg/m<sup>3</sup> and a tensile strain capacity greater than 3.0%.